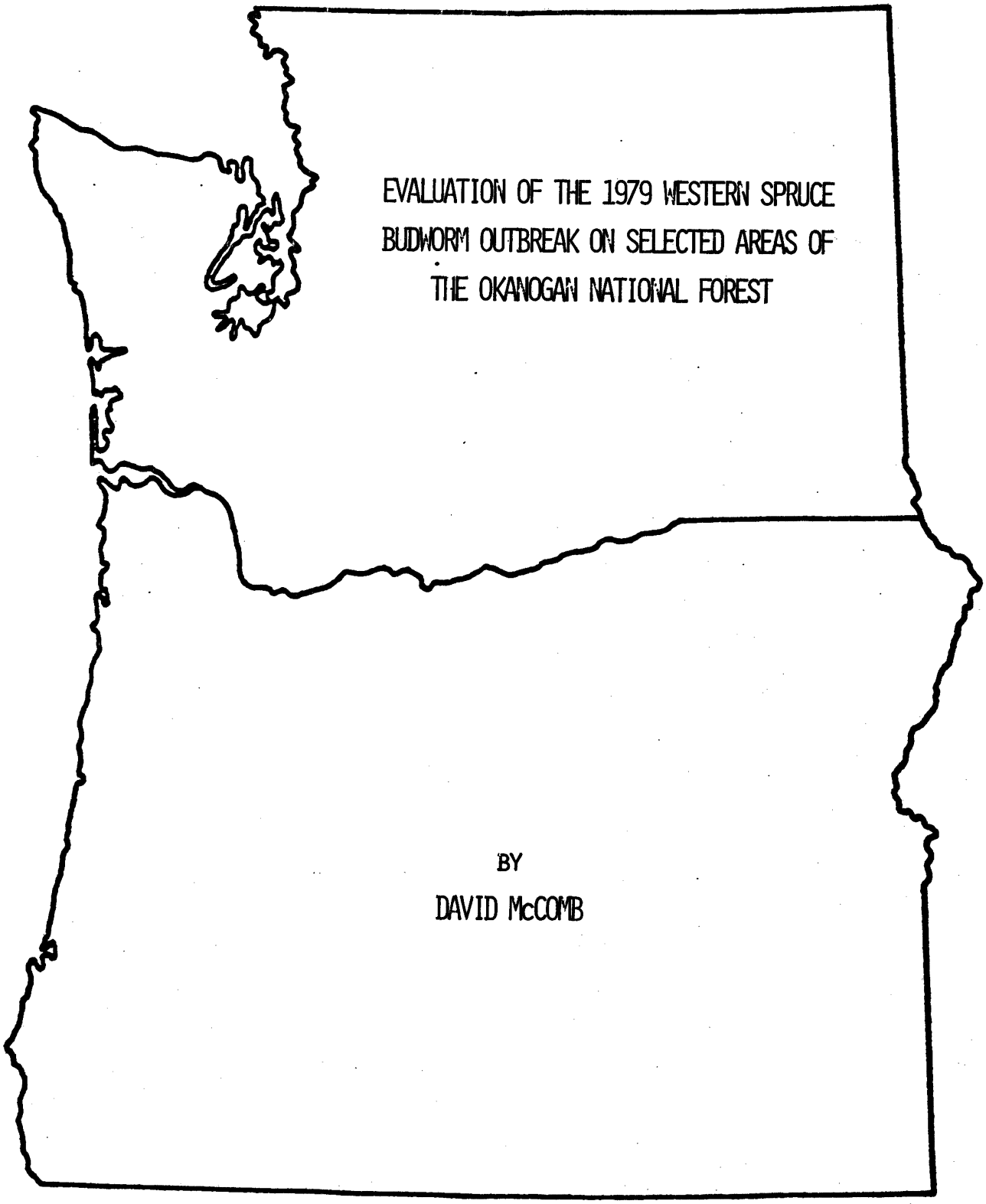
HOS-4V
L029

Forest Insect & Disease Management
Pacific Northwest Region

Forest Service · USDA
Pacific Northwest Region



EVALUATION OF THE 1979 WESTERN SPRUCE BUDWORM OUTBREAK ON SELECTED AREAS OF THE OKANOGAN NATIONAL FOREST

BY

DAVID McCOMB

EVALUATION OF THE 1979 WESTERN SPRUCE BUDWORM OUTBREAK ON SELECTED AREAS OF THE OKANOGAN NATIONAL FOREST

INTRODUCTION

Defoliation by the western spruce budworm *Choristoneura occidentalis*, Freeman has occurred on the Okanogan National Forest yearly since 1970. This defoliation of Douglas-fir and subalpine fir reduces tree growth, kills the tops, and after several years of continuous defoliation, causes tree mortality. The current outbreak was first recorded as light defoliation on 240 acres in the Wolf Creek drainage on the Winthrop Ranger District during the summer of 1970. The infestation increased in size until 354,000 acres of visible defoliation was mapped during the 1976 annual Regional insect aerial detection survey, mainly on the Winthrop and Twisp Ranger Districts. Chemical control that year and in 1977 reduced this acreage to 106,910 acres in 1978. This area consisted of newly-developing infestations on the Conconully and Tonasket Ranger Districts and those areas in the Methow Valley where the budworm pupated before spraying could be completed during 1977.

A biological evaluation, which covered the entire infestation, has been made each fall since 1975. In 1979, the evaluation was limited to those areas where the biological information could aid in the selection of locations for direct operational control, pilot control or research study plots. These areas were the Salamon Creek and Loup Loup drainages on the Conconully Ranger District and the Mount Hull area on the Tonasket Ranger District and adjacent State and private lands.

TECHNICAL INFORMATION

Causal Agent: Western spruce budworm, *Choristoneura occidentalis*, Freeman

Host Trees: Primary hosts of western spruce budworm in this outbreak are Douglas-fir, *Pseudotsuga menziesii* (Mirb.) Franco, and subalpine fir, *Abies lasicarpa* (Hook) Nutt. Western larch *Larix occidentalis* Nutt, was lightly defoliated when growing in association with preferred hosts.

Location and Extent of Outbreak: Aerial detection surveys indicated defoliation by budworm throughout most of the susceptible host type that was not treated during the 1976 and 1977 control projects. Defoliation was also present in the North Cascades National Park on the eastern side of the Cascade Range and on State and private lands adjacent to the National Forest.

Types of Damage: Budworms are usually be found in low numbers throughout the forests of the western United States and Canada. Damage is not noticeable, but when outbreak numbers occur, defoliation of Douglas-fir and true firs becomes serious.

When buds swell in the spring, the overwintering budworm larvae emerge and mine into and feed within the expanding buds. As shoot growth starts, the larvae feed on the current year's needles, often leaving severed needles hanging in webs spun during this period. These severed needles and partly consumed foliage turns brown, giving the tree a scorched appearance. During outbreaks, budworm feeding may destroy practically all of the new needle growth.

Defoliation by the budworm reduces tree growth and, depending on the size and vigor of the trees, can cause tree mortality after 4 or 5 successive years of defoliation. Trees with less defoliation may suffer only loss in diameter and height growth or top-kill. Subsequently, weakened trees may be attacked and killed by bark beetles. During past outbreaks, Douglas-fir beetles have been recorded as causing serious damage to budworm-infested stands of Douglas-fir (Johnson 1975).

Environmental Factors: Major environmental factors contributing to the continuation of the current outbreak may have been the warm, dry weather during the larval feeding and moth flight periods plus an adequate quantity of host foliage.

METHODS

The density of egg masses are indicative of the number of larvae which will be present the following spring and the amount of defoliation can be generally related to the larval population. Since egg masses are available for sampling for over six months per year, they provide a sampling stage for large infestations.

An aerial insect detection survey followed by ground checking delineated the currently defoliated area. Land use managers from the Okanogan National Forest and the Washington State Department of Natural Resources at a meeting August 22, 1979 used data and maps from these aerial surveys to select areas where direct budworm control as a pilot project might be considered. The two areas selected at this meeting were subsequently sampled during the egg mass survey.

An egg survey plot consisting of three host trees on one acre of land was established in each land section within these boundaries. These trees were limited to Douglas-fir or true firs small enough (25-50 feet) to be sampled at midcrown with a 16-foot pole pruner. Two 30-inch long bud bearing branches were removed from opposite quadrants of each of the trees.

Plot number, tree species, sampling data, collector's name, and location by township, range, and section was recorded for each plot. After being measured for foliated length and width, each branch was placed in a separate paper bag that was labeled with the number of the branch, tree, and plot. Branches were kept in cool storage while awaiting examination in the laboratory.

In the laboratory, the foliage was examined, egg masses and any needle containing anything suspected as part of an egg mass was removed and placed in a small Petri dish with the plot number recorded on the bottom. Using a microscope, an entomologist examined all these needles and separated the egg masses into two categories: new (summer 1979) and old (1978 or earlier). The number of new egg masses per 1,000 square inches of foliage was calculated using the sample branch measurements recorded in the field, foliage area was computed -

length of foliage X width of foliage = square inches of foliage sampled.
2

Egg mass density counts were plotted on unit maps and areas delineated to show where moderate and heavy budworm defoliation can be expected in 1980 (Appendix). Defoliation values used were those established by Carolin and Coulter (1972) Table 1.

Table 1.--Western spruce budworm egg mass densities and expected defoliation the following spring.

Egg masses per 1000 square inches	Expected Degree	Defoliation Percent
.1 to 1.3	very light	0 - 15
1.4 to 3.5	light	16 - 25
3.6 to 8.9	moderate	26 - 50
9.0 to 17.7	heavy	51 - 90
17.7 up	very heavy	91 - 100

Conconully Unit - Located in the Salamon Creek drainage northwest of Okanogan, Washington, this unit of 60,000 acres is equally divided in ownership between the Forest Service and the Washington State Department of Natural Resources. The main drainages are: Loup Loup, Rock, and the north, west, and south forks of Salamon Creek.

Within the units are located 7 Forest Service and 2 State-owned campgrounds and the town of Conconully. Host type is mainly Douglas-fir with some subalpine fir at higher elevations. Logging and recreational roads make this area fairly accessible.

Budworm defoliation was first recorded on the Conconully Unit during the 1977 aerial survey. In 1977 and 1978, small scattered patches of defoliation were observed in the vicinity of Cottonwood and State Cabin Campgrounds and on Funk and Muckamuck Mountains. Light to moderate defoliation was visible throughout most of this unit when the 1979 aerial survey was flown. Accumulated damage is still light with some top-kill present in the Cottonwood Campground area.

Mount Hull - Centered six miles southeast of Oroville, Washington on the Canadian border, this unit is approximately 20,000 acres in size and located on Okanogan National Forest lands with 10 to 15 percent of the perimeter in private ownership. The area of visible defoliation is centered around Mount Hull with some areas of extremely heavy defoliation, while in other areas defoliation is light or absent.

Light defoliation was first recorded in a small area on the southwest side of the mountain in 1976. Since then, defoliation has occurred in most of the host type at low and mid elevations of the unit. Host type is mainly Douglas-fir but an understory of larch has considerable defoliation.

There are no improved campgrounds or recreational areas within the unit and much of the area is inaccessible by motor vehicle.

RESULTS

Conconully Unit - During September, 1979, 112 budworm egg mass survey plots were established and sampled in this unit. Counts on these plots ranged from 0 to 12.8 new egg masses per 1000 square inches of foliage (Table 2). On 59 plots located within the core of the unit, counts averaged 3.8 plots with the highest number of eggs located in the valley bottoms but not restricted to any specific elevation. Counts on 53 plots located on the perimeter of the defoliated area averaged 0.7 new masses per 1000 square inches. Many of these plots were established in an attempt to determine the edge of the infested area.

Egg mass counts indicate that defoliation will continue throughout this unit during 1980 and there may be an expansion in the area of visible defoliation. Moderate defoliation will occur in the unit, but there will be pockets or localized areas of heavy defoliation, probably in the Rock Lake, Ruby Mountain, Wagon Camp, Kerr Campground, and Funk Mountain areas.

Mount Hull Unit - Budworm egg masses decreased in density from 4.3 on 10 land sections in 1978 to 2.3 on the 35 sections surveyed in the fall of 1979. A comparison of data only from plots surveyed both years showed a decrease from 4.3 to 2.7 new egg masses (Table 4). These counts indicate that the unit will receive light defoliation during 1980; however, there are areas located within the unit where egg counts ranging from 3.9 to 10.4 indicate moderate to heavy defoliation (Table 3).

Budworm larval surveys made in this unit during the spring of 1979 averaged 35.3 per 100 buds rather than the 13.6 expected from the 4.3 egg count made in the fall of 1978 (Table 4). There is a possibility that Carolin and Coulter's (1972) projections of egg counts, resulting larvae, and expected degree of defoliation may be low for this unit and a greater degree of defoliation may occur than is predicted.

SUMMARY AND RECOMMENDATIONS

Budworm populations will ocur in numbers great enough to cause moderate to heavy defoliation (26 to 90%) during 1980 on large areas in the Conconully and Mount Hull units. Top-kill and growth loss will continue over most of these units and the rate of tree mortality will accelerate in the older areas of the infestation.

We recommend that these areas be used for field or pilot testing of biological and other integrated control methods. Adequate areas are available and there is considerable time difference in the larval development rate between the two units and within the Conconully Unit, making possible the scheduling of field tests in an efficient manner using a minimum number of personnel and aircraft.

Prepared by: David McComb

DAVID McCOMB, Entomologist
Forest Insect and Disease Management
State and Private Forestry

Reviewed by: Roger E. Sandquist

ROGER E. SANDQUIST, Entomology Group Leader
Forest Insect and Disease Management
State and Private Forestry

Approved by: for Randall S. Sedivec

PAUL E. BUFFAM, Director
Forest Insect and Disease Management
State and Private Forestry

REFERENCES CITED

Carolin V. W., and W. K. Coulter
1972. Sampling populations of western spruce budworm and predicting defoliation on Douglas-fir in eastern Oregon. USDA, FS, Res. Paper PNW-149. 38 pp.

Johnson, P. C., and R. E. Denton
1975. Outbreaks of the western spruce budworm in the American Northern Rocky Mountain area from 1922 through 1971. USDA, FS, General Technical Report INT-20. 144 pp.

Table 2.--Western Spruce Budworm Egg Mass Survey - Fall 1979
Conconully Unit - Okanogan National Forest

Location			Sq. In.	Egg Masses		Per 1000 Sq. In.	
T.	R.	Sec.	Foliage	Old	New	Old	New
33N	24E	1	2,205	1	1	0.5	0.5
		2	2,520	6	12	2.4	4.8
		3	2,205	0	1	0	0.5
		4	1,815	6	4	3.3	2.2
		5	1,915	1	1	0.5	0.5
		8	1,700	3	7	1.8	4.1
		9	2,205	0	3	0	1.4
		10	2,310	0	1	0	0.4
		11	1,785	16	14	9.0	7.8
		15	2,025	2	3	1.0	1.5
		16	1,911	0	0	0	0
34N	24E	1	2,370	14	17	5.9	7.2
		2	2,250	5	10	2.2	4.4
		3	2.025	5	8	2.5	4.0
		4	1,950	7	12	3.6	6.2
		9	1,890	0	2	0	1.0
		11	2,340	22	30	9.4	12.8
		12	2,027	1	5	0.5	2.5
		13	1,920	0	5	0	2.6
		14	1,544	3	3	1.9	1.9
		16	1,965	1	1	0.5	0.5
		19	1,745	1	4	0.6	2.3
		20	1,785	0	0	0	0
		21	1,275	0	0	0	0
		22	1,505	0	0	0	0
		23	2,237	5	21	2.7	9.4
		24	1,680	1	4	0.6	2.4
		25	1,763	0	0	0	0
		26	2,025	2	3	1.0	1.5
		27	1,755	19	10	10.8	5.7
		28	1,620	0	0	0	0
		29	1,710	3	3	1.8	1.8
		32	1,485	2	2	1.3	1.3
		33	1,725	0	2	0	1.2
		34	2,145	6	13	2.8	6.1
		36	2,385	2	3	0.8	1.3
34N	25E	5	1,545	1	1	0.6	0.6
		6	1,815	1	7	0.6	3.9
		7	1,711	1	8	0.6	4.7
		8	1,590	0	0	0	0
		17	1,905	0	0	0	0
		18	2,055	0	1	0	0.5
		19	1,620	0	0	0	0
		20	2,340	2	5	0.8	2.1
		21	2,235	3	0	1.3	0
		29	2,197	1	1	0.5	0.5
		30	2,265	0	2	0	0.9

Table 2.--Western Spruce Budworm Egg Mass Survey - Fall 1979
Conconully Unit - Okanogan National Forest (Continued)

Location			Sq. In.	Egg Masses		Per 1000 Sq. In.	
T.	R.	Sec.	Foliage	Old	New	Old	New
35N	23E	1	1,635	9	14	5.5	8.6
		2	1,410	0	1	0	0.7
		11	2,045	1	0	0.5	0
		12	1,950	1	3	0.5	1.5
		13	1,395	2	1	1.4	0.7
		14	1,548	0	0	0	0
		24	1,972	0	1	0	0.5
35N	24E	3	1,955	1	2	0.5	1.0
		4	1,875	0	7	0	3.7
		5	1,726	3	4	1.7	2.3
		6	1,890	0	2	0	1.1
		8	1,860	9	7	4.8	3.8
		9	2,040	6	2	2.9	1.0
		10	2,070	6	12	2.9	5.8
		14	1,925	7	4	3.6	2.1
		15	1,695	0	0	0	0
		16	2,355	1	5	0.4	2.1
		17	1,905	8	10	4.2	5.2
		18	1,770	0	0	0	0
		22	1,350	9	3	6.7	2.2
		23	1,396	2	4	1.4	2.9
		24	1,995	0	2	0	1.0
		25	2,130	4	11	1.9	5.2
		26	2,055	1	1	0.5	1.0
		27	1,845	0	2	0	1.1
		33	1,850	0	5	0	2.7
		34	1,650	7	8	4.2	4.8
		35	2,055	13	16	6.3	7.8
		36	2,235	9	10	4.0	4.5
35N	25E	29	2,085	0	0	0	0
		30	1,709	2	2	1.2	1.2
		31	1,785	1	20	0.6	11.2
		32	2,041	2	0	1.0	0
36N	23E	24	1,965	0	0	0	0
		25	2,115	1	0	0.5	0
		36	2,055	1	5	0.5	2.4
36N	24E	2	1,545	1	0	0.6	0
		3	2,238	1	1	0.4	0.4
		4	1,560	0	0	0	0
		8	1,590	0	1	0	0.6
		9	1,920	0	0	0	0
		10	1,845	0	0	0	0
		13	1,995	0	0	0	0
		14	1,920	6	4	3.1	2.1

Table 2.--Western Spruce Budworm Egg Mass Survey - Fall 1979
Conconully Unit - Okanogan National Forest (Continued)

Location			Sq. In.	Egg Masses		Per 1000 Sq. In.	
T.	R.	Sec.	Foliage	Old	New	Old	New
36N	24E	15	2,030	0	2	0	1.0
		16	2,205	0	0	0	0
		21	1,830	0	1	0	0.5
		22	2,338	1	3	0.4	1.3
		23	1,530	1	4	0.7	2.6
		24	1,785	1	7	0.6	3.9
		25	1,980	1	3	0.5	1.5
		26	1,920	14	9	7.3	4.7
		27	1,993	1	3	0.5	1.5
		28	1,920	1	2	0.5	1.0
		29	2,070	4	9	1.9	4.3
		30	2,070	0	2	0	1.0
		31	1,485	1	2	0.7	1.3
		32	1,680	2	4	1.2	2.4
		33	1,920	2	11	1.0	5.7
		36	1,710	0	5	0	2.9
36N	25E	7	1,575	0	3	0	1.9
		18	2,265	12	14	5.3	6.2
		19	2,220	5	20	2.3	9.0
		21	1,625	0	1	0	0.5
		28	1,995	2	2	1.0	1.0
		33	2,130	1	1	0.5	0.5

Table 3.--Western Spruce Budworm Egg Mass Survey - Fall 1979
Mount Hull Unit - Okanogan National Forest

Location			Sq. In.	Egg Masses		Per 1000 Sq. In.	
T.	R.	Sec.	Foliage	Old	New	Old	New
39N	27E	1	1,935	5	6	2.6	3.1
		2	1,650	1	1	0.6	0.6
		11	1,680	1	3	0.6	1.8
		12	1,968	3	10	1.5	5.1
		13	1,384	5	7	3.6	5.1
		14	1,680	0	0	0	0
		24	1,605	3	8	1.9	5.0
39N	28E	2	1,845	10	5	5.4	2.7
		3	1,547	4	6	2.6	3.9
		4	1,506	9	7	6.0	4.6
		8	1,463	1	0	0.7	0
		9	2,163	3	13	1.4	6.0
		10	1,554	1	4	0.6	2.6
		11	1,674	2	2	1.2	1.2
		13	1,725	20	18	11.6	10.4
		14	1,848	0	0	0	0
		15	1,770	0	1	0	0.6
		16	1,970	0	2	0	1.0
		17	2,055	1	1	0.5	0.5
		18	2,092	1	1	0.5	0.5
		19	1,815	0	6	0	3.3
		20	1,611	0	2	0	1.2
		21	1,595	0	2	0	1.2
		23	1,869	0	0	0	0
		24	1,925	0	3	0	1.6
39N	29E	18	1,799	2	2	1.1	1.1
		19	2,055	10	11	4.9	5.4
40N	28E	19	2,100	0	1	0	0.5
		21	1,680	0	2	0	1.2
		28	2,250	4	12	1.8	5.3
		29	2,071	0	1	0	0.5
		30	1,845	0	0	0	0
		33	1,665	2	3	1.2	1.8
		34	1,740	9	3	5.2	1.7
		35	1,740	0	2	0	1,1

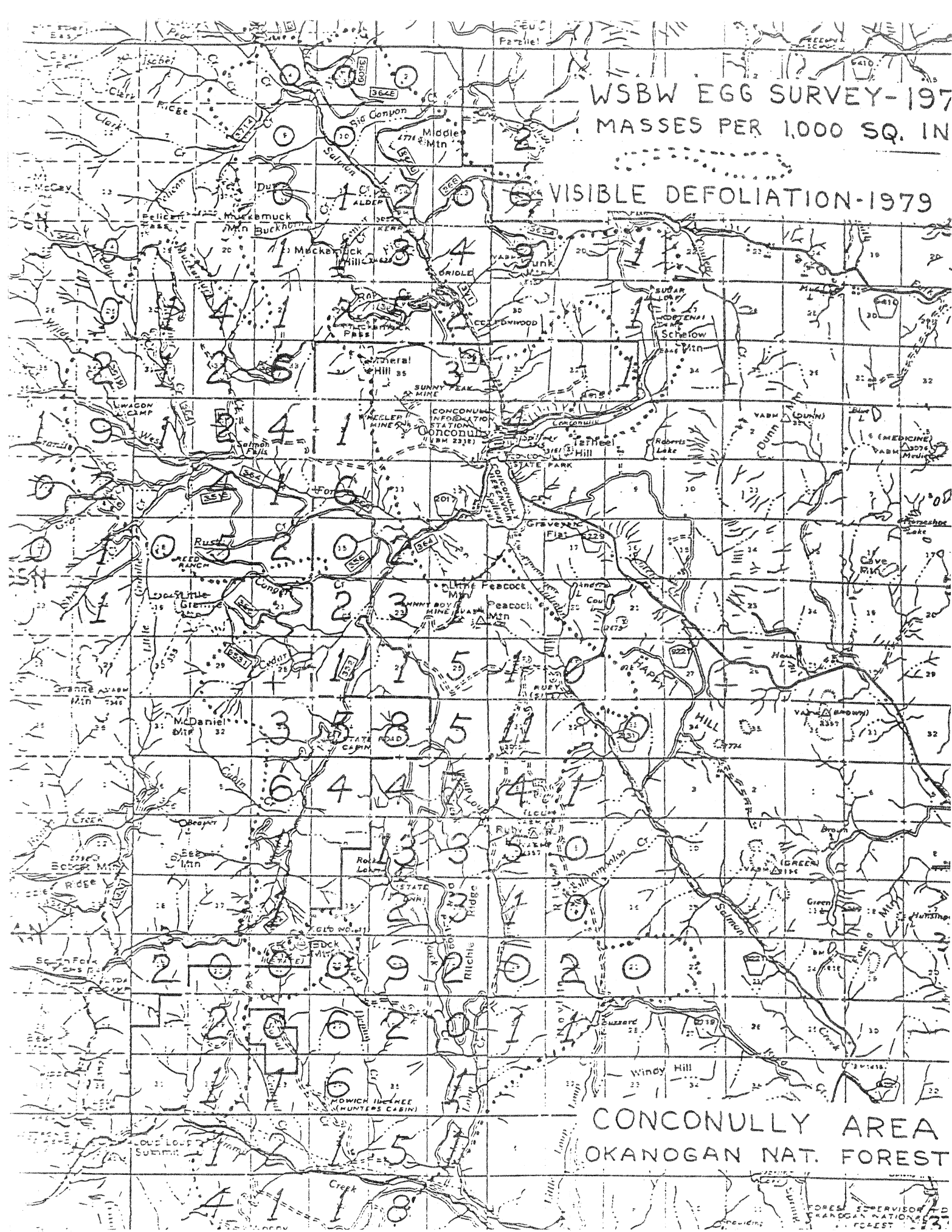
Table 4.--Western Spruce Budworm Populations on Mount Hull, Okanogan National Forest, During 1978 and 1979 Egg Mass Surveys and the Early Larval Stage on July 4 and 5, 1979

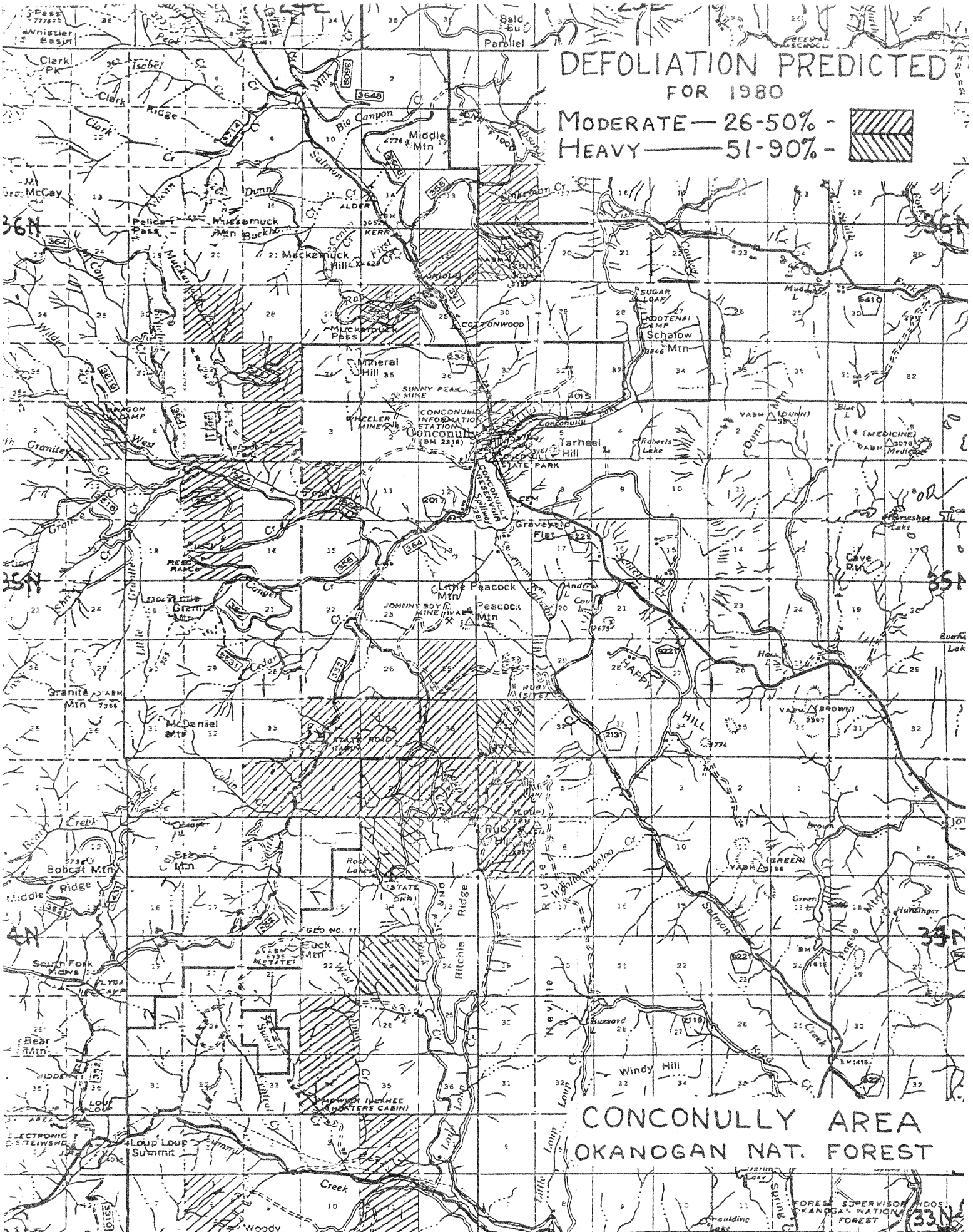
Plot number[1/]	Eggs 1978[2/]	Larvae 1979[3/]	Eggs 1979[2/]
39-27-01	4.3	40.7	3.1
39-27-12	9.3	57.4	5.1
39-27-13	6.9	23.8	5.1
39-28-02	7.7	32.6	2.7
39-28-03	5.3	59.0	3.9
39-28-04	3.4	32.8	4.6
39-28-08	0	8.3	0
39-28-17	1.5	31.6	0.5
39-28-18	1.8	38.8	0.5
40-28-34	3.2	27.6	1.7
MEAN	4.3	35.3	2.7

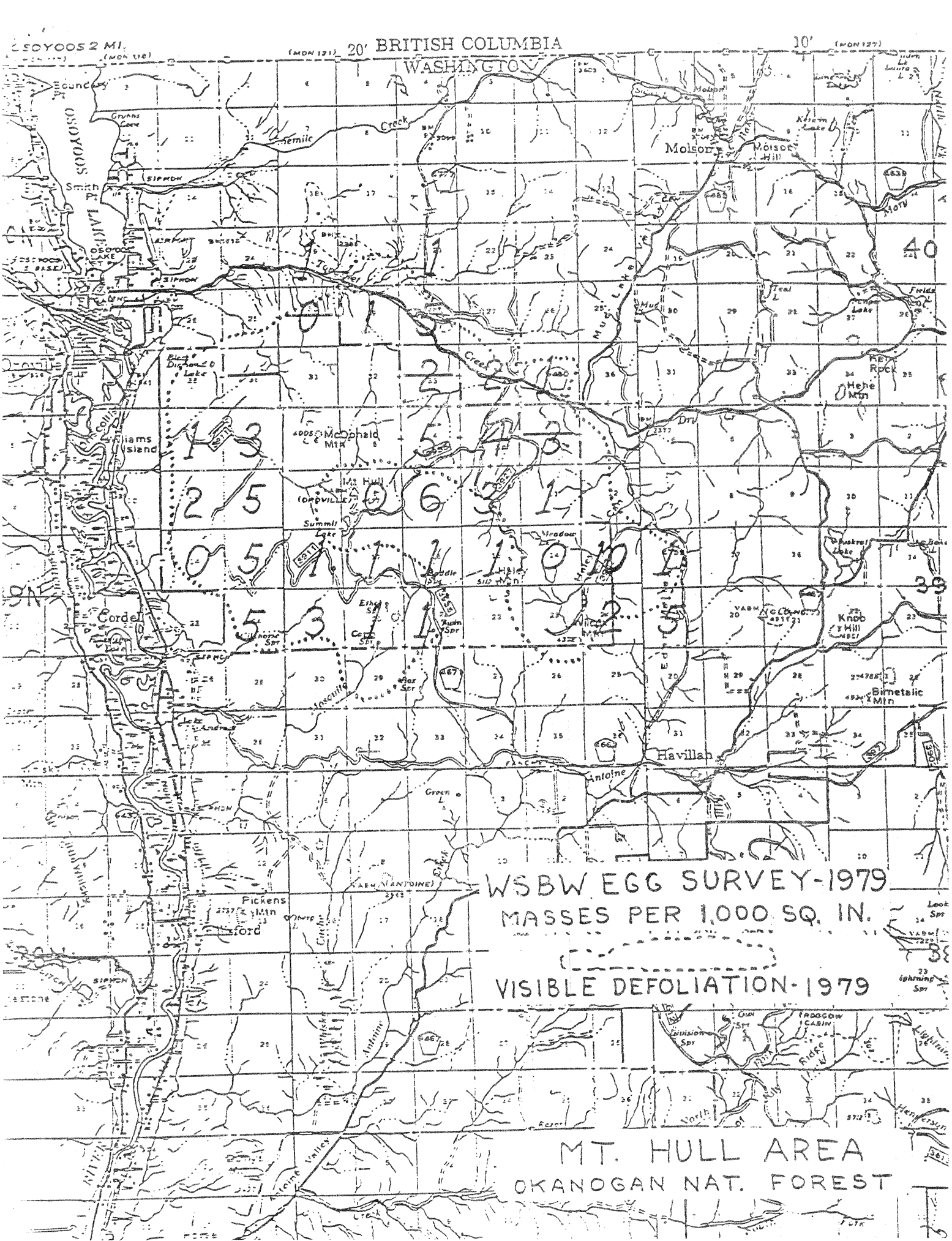
1/ Plot number indicates township, range, and section.

2/ New egg masses per 1,000 square inches of foliage.

3/ Larval counts per 100 buds, mainly in 4th instar.


WSBW EGG SURVEY-197
MASSES PER 1,000 SQ. IN
VISIBLE DEFOLIATION-1979
CONCONULLY AREA
OKANOGAN NAT. FOREST
Middle Mtn
Sig Canyon
Salmon
Muckamuck Mtn
Buckhorn
Muckamuck Hill
Muckamuck Pass
Oriole
Sugar Loaf
Scherow Mtn
Mineral Hill
Sunny Peak Mine
Wagon Camp
Salmon Falls
Conconully Information Station
Conconully
Conconully State Park
Conconully Reservoir
Spillway
Roberts Lake
Graveyard Flat
Reed Ranch
Little Peacock Mtn
Peacock Mtn
Cedar
McDaniel Mtn
State Road
Cabin
Loup Loup Summit
Rattlesnake Ridge
Ruby
Brown
Green
Windy Hill
Mowich (Huckleberry Hunters Cabin)
Forest Supervisor
Okanogan National Forest


DEFOLIATION PREDICTED
FOR 1980
MODERATE — 26-50% -
HEAVY — 51-90% -
CONCONULLY AREA
OKANOGAN NAT. FOREST
Conconully
Conconully Reservoir
Sinlahekin
Salmon
Middle Mtn
Mineral Hill
Tarheel Hill
Schafow Mtn
Sugar Loaf
Kootenai Camp
Sunny Peak Mine
Wheeler Mine
Roberts Lake
Graveyard Flat
Little Peacock Mtn
Peacock Mtn
Jumpin Boy Mine
Granite Mtn
McDaniel Mtn
Bobcat Mtn
Bear Mtn
Buck Mtn
Windy Hill
Loup Loup Summit
Loup Loup Creek
Salmon Creek
Ruby Creek
Ruby Hill
Ritchie Ridge
Neville Ridge
Whitmanmoloo Ct.
Forest Supervisor
Okanogan National Forest
36N
35N
34N
33N



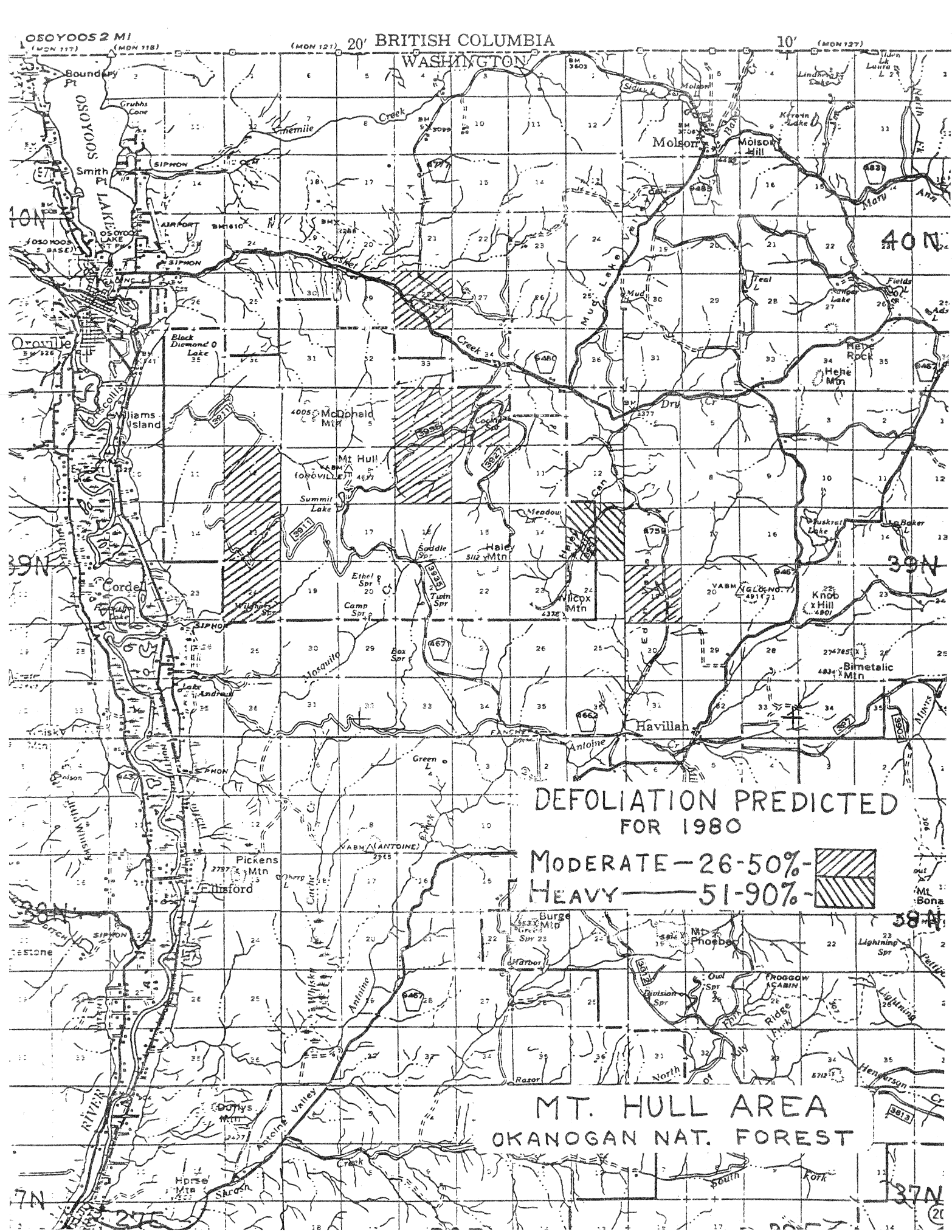
WSBW EGG SURVEY-1979

MASSES PER 1,000 SQ. IN.

VISIBLE DEFOLIATION-1979

MT. HULL AREA

OKANOGAN NAT. FOREST


OSOYOOS 2 MI
(MON 117)
(MON 118)
(MON 121)
20' BRITISH COLUMBIA
WASHINGTON
10'
(MON 127)
Boundary Pt
Grubbs Cove
Smith Pt
SIPHON
AIRPORT
OSOYOOS LAKE ST PK
OSOYOOS (CANADIAN BASE)
Osoyoos Lake
Tuppacher
Orovilla
Black Diamond O Lake
Williams Island
McDonald Mtn
Mt Hull
(OROVILLE)
Summit Lake
Cordell
Lake Andrews
Molson
Molson Hill
Mud Lake
Teal L
Fields L
Hehe Rock
Hehe Mtn
Dry Cr
Meadow
Haley Mtn
Saddle Spr
Ethel Spr
Twin Spr
Camp Spr
Wilcox Mtn
Knob Hill
Bimetalic Mtn
Havillah
Antoine Cr
Green L
Mosquito
Box Spr
Pickens Mtn
Ellisford
(ANTOINE)
Burge Mtn
Harbor
Mt Phoebe
Owl Spr
Division Spr
Proggow Cabin
Lightning Spr
Lightning
Ridge
Razor
North
Henderson
Dutlys Mtn
Antoine Valley
Horse Mtn
Sarson
South
Fork
Mt Bona
40N
39N
38N
37N
DEFOLIATION PREDICTED
FOR 1980
MODERATE—26-50%
HEAVY—51-90%
MT. HULL AREA
OKANOGAN NAT. FOREST